

# The Greek National Observatory of Forest Fires

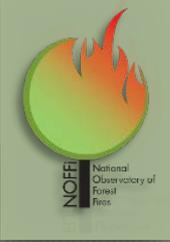
Development of services and their promotion  
in the Balkan region



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**Laboratory of Forest Management and Remote Sensing**  
**Aristotle University of Thessaloniki, Greece**

<http://fmrs.web.auth.gr/>



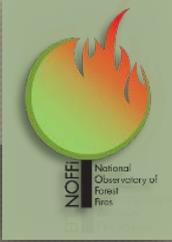


# National Observatory Of Forest Fires (NOFFi)

An initiative to establish an **observatory** of forest fires in Greece.

**NOFFi** aims to:

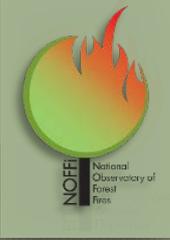
- develop **products** and **services** related to the **prevention** and **impact assessment** of forest fires in order to **assist** forest fire management.
- promote the **transboundary** cooperation with neighboring **Balkan** countries through common innovative services.



# National Observatory Of Forest Fires (NOFFi)

## Services that were developed under NOFFi:

1. A fuel type mapping methodology
2. A burned area mapping service
3. A mid-term forest fire danger index
4. A web-based GIS platform



## Implementation agencies – Financing

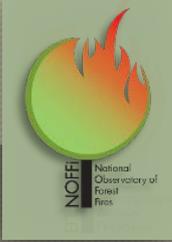
Supervision: Ministry of Environment and Energy

Cooperation: Laboratory of Forest Management and  
Remote Sensing, AUTH  
interBalkan Environment Center (i-BEC)

Financing: Green Fund

Start date: March 2014

Duration: 42 months



## Fuel type mapping (NOFFi-FTM)

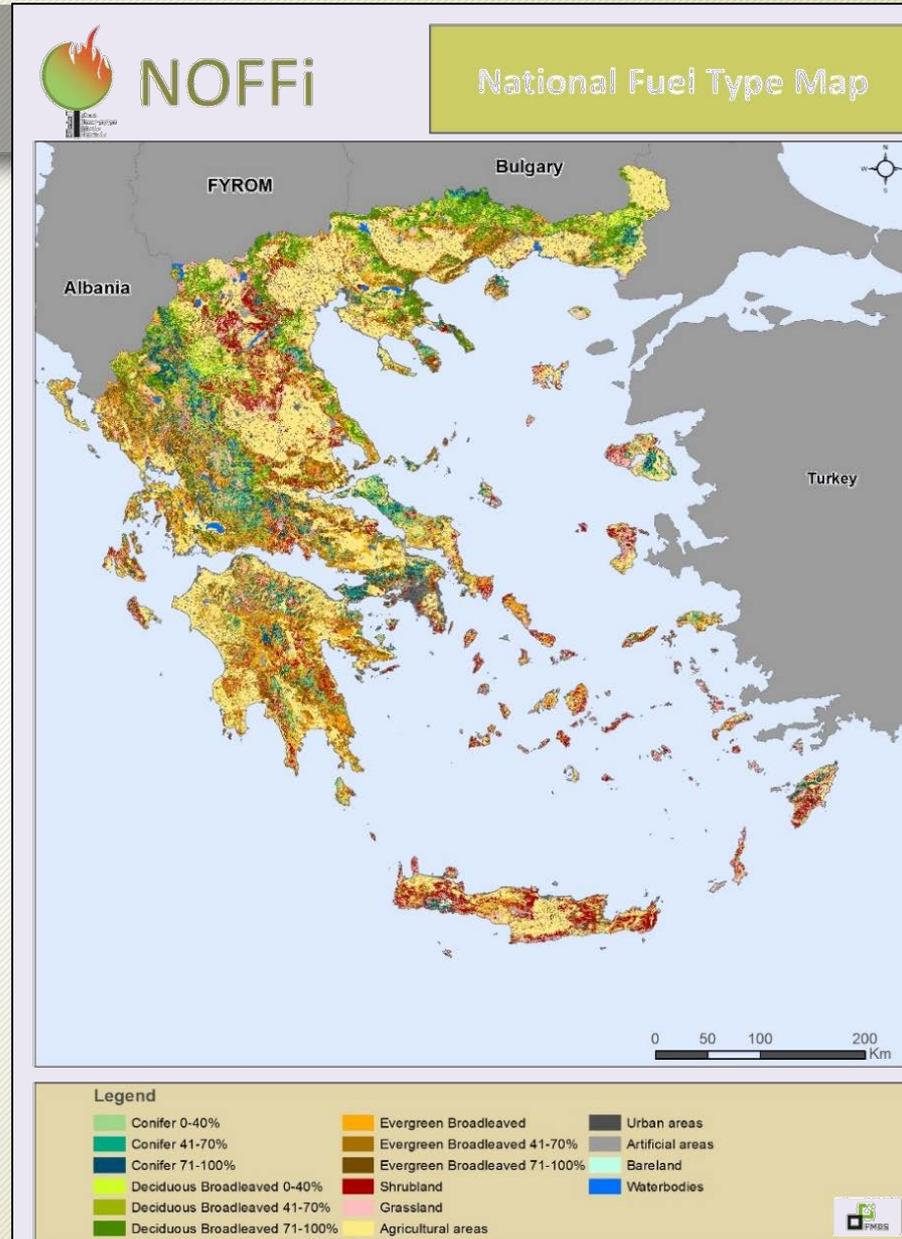
### Up-to-date mapping methodology

- Mixed approach mainly based on the analysis of **satellite** imagery; use of existing maps (LPIS-ILOTS, official forest density) as ancillary data
- Capability to easily **update** the final fuel-type map (depends on image availability - no real problem these days)
- **Typical** fuel type classification scheme
- The product is easily **comparable** with other fuel type mapping products such as the JRC FUELMAP and ArcFUEL
- **Descriptive criteria** can be easily added to discriminate specific classes (sub-urban forests, riparian vegetation etc.)

## Fuel type mapping

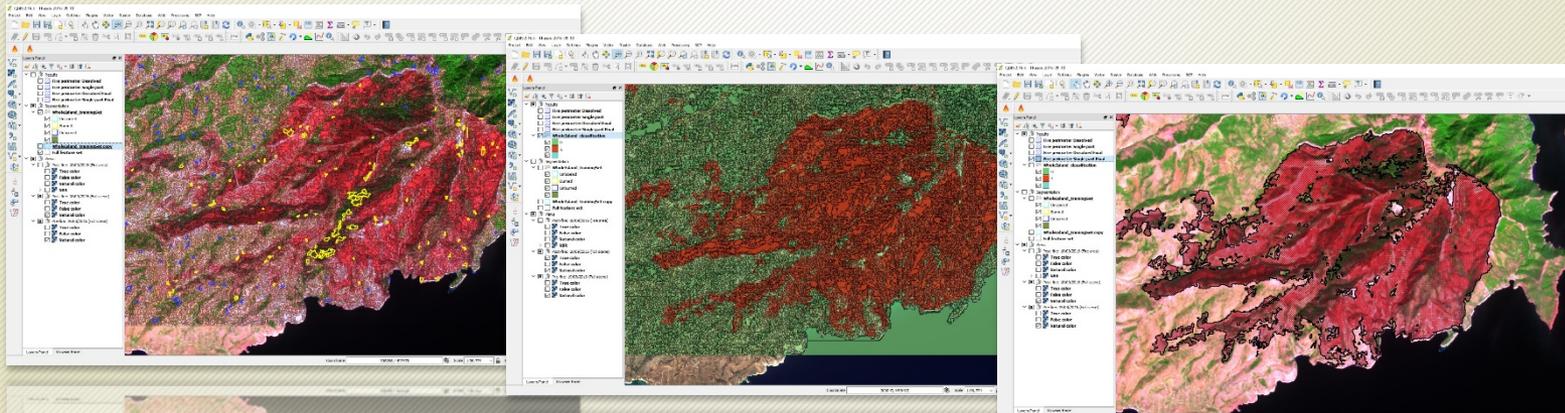
### Main points:

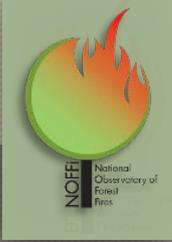
- The final product found to be very accurate (overall accuracy **92.59%** using **7626** LUCAS points)
- The product can be easily **updated** in order to take into account changes due to the following:
  - Wildfires
  - Afforestation of abandoned agricultural areas
  - Deforestation, clearances etc.
- The methodology could **be used** in other countries of the region for which similar ancillary data are available



## Burned area mapping service (NOFFi-OBAM)

- Advanced methodology exploiting state-of-the-art machine learning algorithms for **highly accurate maps**
- Primary focus on high-resolution freely distributed satellite data (Copernicus Sentinel-2)
- Implemented as a **QGIS plugin**
- Requires mild user interaction (approximately 30 minutes for large wildfires)





## Burned area mapping service (NOFFi-OBAM)

- ❑ NOFFi-OBAM was operationally employed during:
  - **2016:** 30 wildfires in Greece (25,683.72 ha),  
2 in Cyprus (2,610.05 ha),  
1 between FYROM & Greece (880.63 ha)
  - **2017:** 80 wildfires in Greece (20,643.62 ha)  
2 between Albania & Greece (611.88 ha)
  
- ❑ The results were **provided to** the following **users**:
  - General Secretariat for Civil Protection,
  - Central forest service\*,
  - Local forestry service departments, and
  - other stakeholders (WWF-Hellas, NGOs, research institutes)

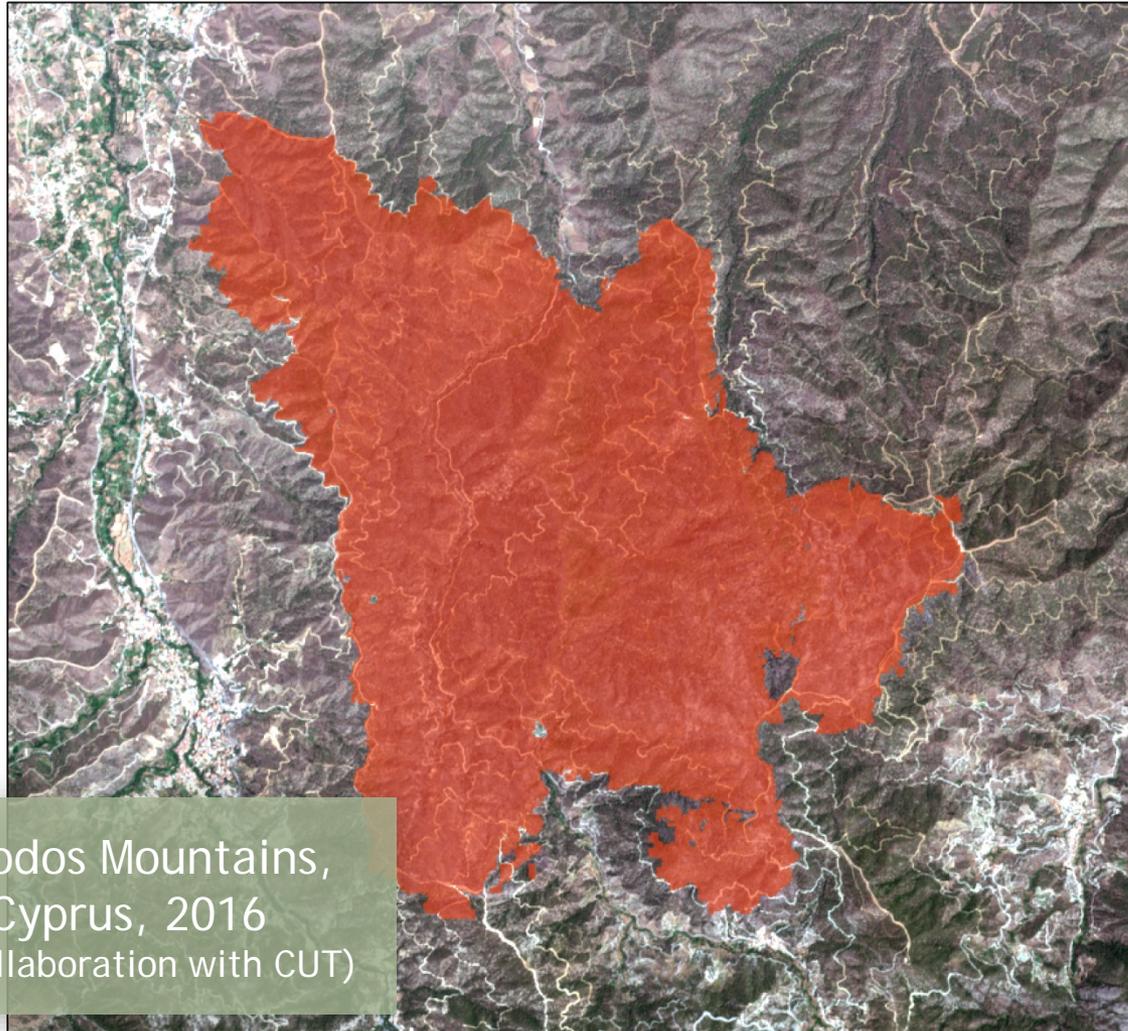
\* Directorate General for the Development and Protection of Forests and Rural Environment, Hellenic Ministry of Environment and Energy



## Burned area mapping service (NOFFi-OBAM)

- ❑ **Examples of collaboration** with neighboring countries:
  - The service was used in **Cyprus** for the mapping of two major wildfires (Soleas and Agraka) in collaboration with CUT
  - Mapping of a large fire that started in **FYROM** and crossed the borders with Greece (2016)
  - Mapping of all large fires that started in **Albania** and crossed the borders with Greece (2017)
  
- ❑ Ongoing collaboration with the **EFFIS team** for comparison and evaluation of the operational burned area mapping on a **National/European** level using Sentinel-2 data.
  
- ❑ Organization of webinar for **knowledge transfer** to stakeholders in the **Balkan region** (provisionally scheduled for mid-December 2017)

# NOFFi-OBAM Mapping Examples



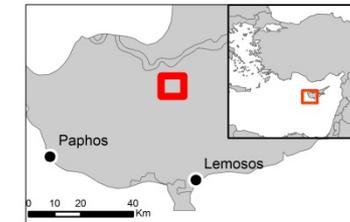
Troodos Mountains,  
Cyprus, 2016  
(In collaboration with CUT)



## SOLEAS - CYPRUS

Fire Incident  
19.06.2016

Scale 1:20.000

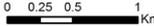


 Burned area (1868.20 ha)

### Background:

 Sentinel-2 satellite image (10m)  
Acquisition date 28.06.2016

### Cartographic information:

 0 0.25 0.5 1 Km



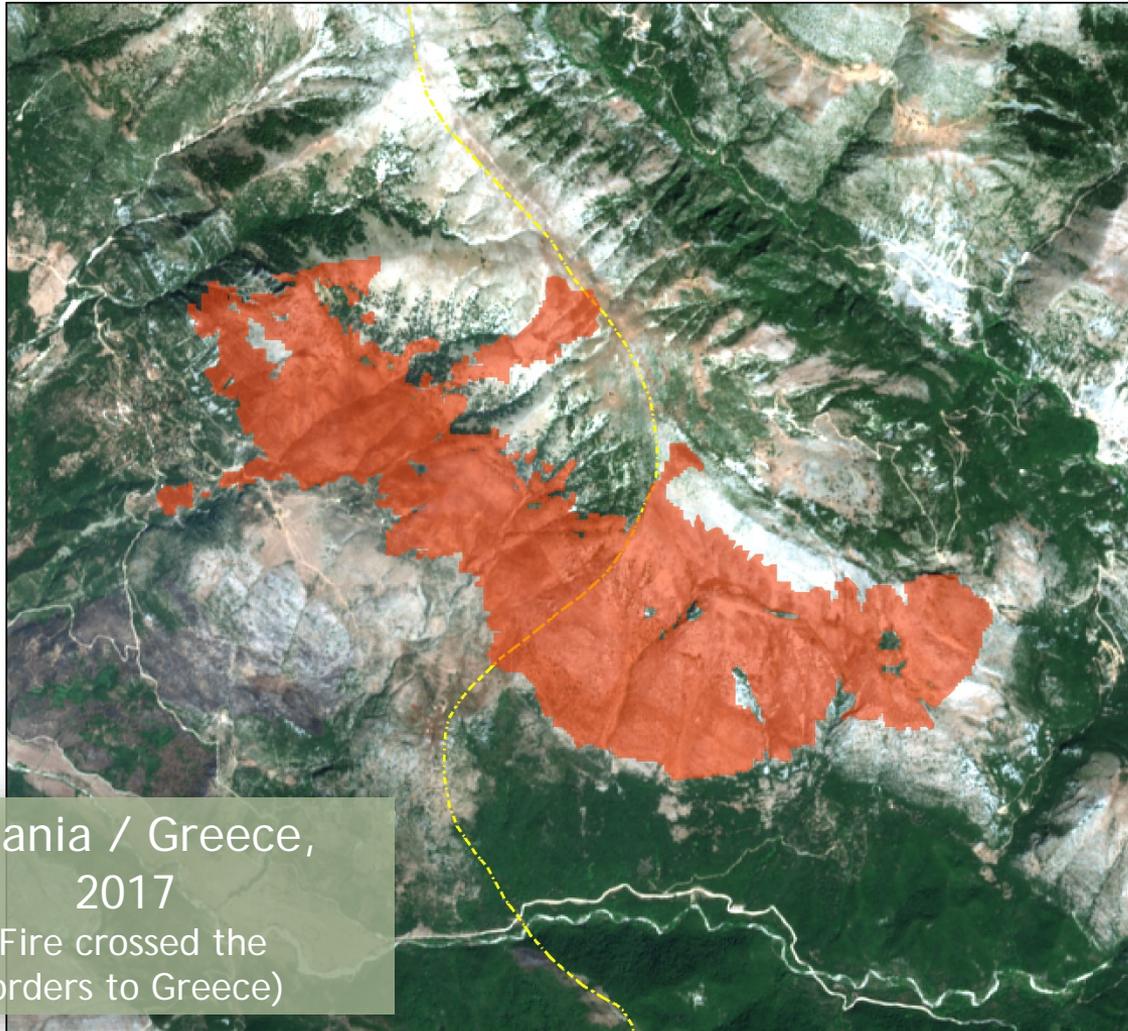
Projected Coordinate System:  
UTM Zone 34 North, Datum: WGS 84

This mapping has been produced in the context of the research project "National Observatory of Forest Fires – NOFFi", which is being developed by the Laboratory of Forest Management and Remote Sensing of AUTH in collaboration with the Directorate General for the Development and Protection of Forests and Rural Environment of the Hellenic Ministry of Environment and Energy.



It should be stressed out that the burned area perimeter delineated using satellite imagery by the NOFFi-OBAM service represents an estimation of the true burned area – valid for the date and time of the satellite image acquisition – and cannot in any case substitute the official affected area perimeter defined by the public authorities legally responsible for that task.

# NOFFi-OBAM Mapping Examples




**NOFFi**  
Burned Area Mapping Service  
NOFFi-OBAM

## ALBANIA / GREECE

Fire Incident  
**06.08.2017**

Scale 1:20.000



 Burned area (477.73 ha)

### Background:

 Sentinel-2 satellite image (10m)  
Acquisition date 25.08.2017

### Cartographic information:

0 0.25 0.5 1 Km 

Projected Coordinate System:  
UTM Zone 34 North, Datum: WGS 84

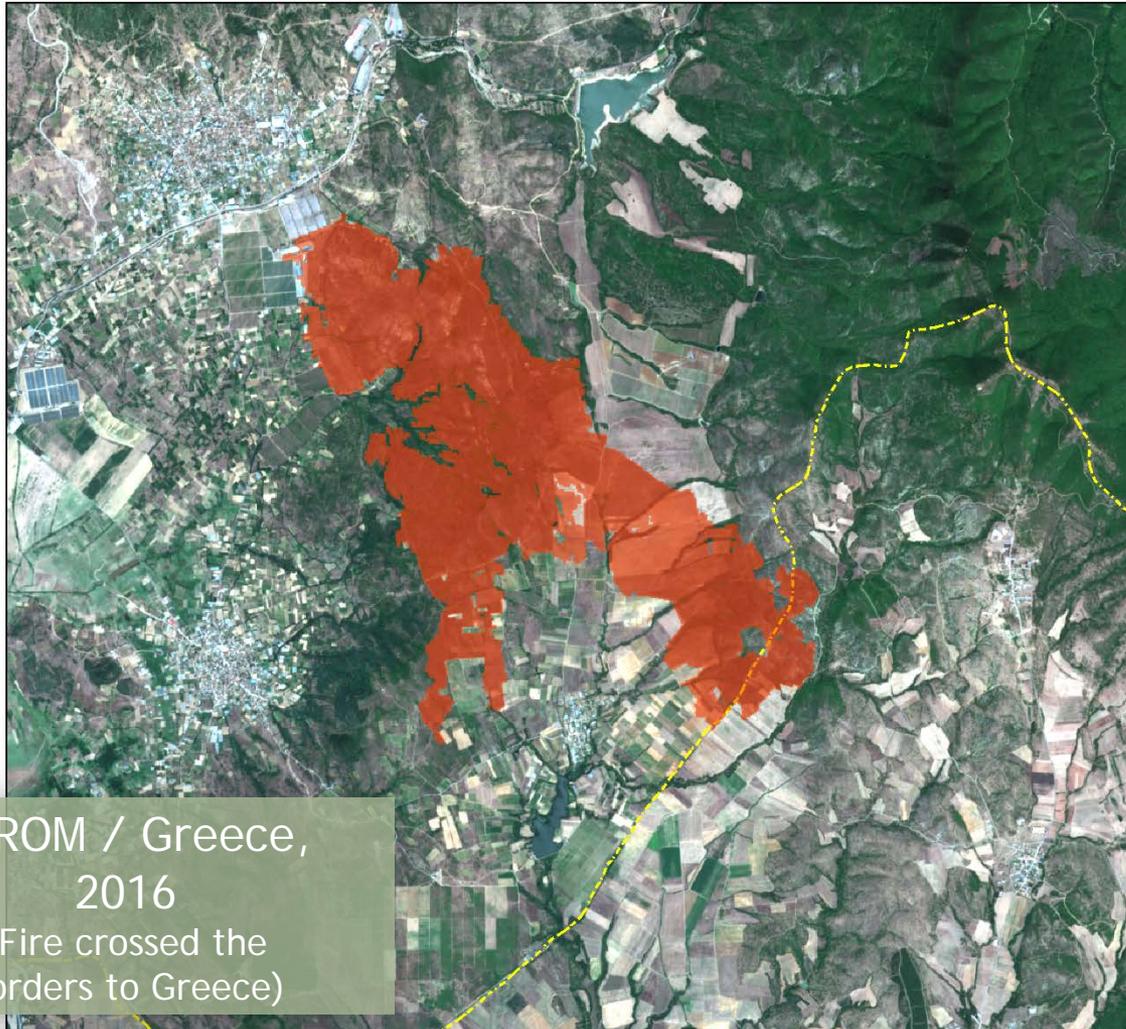
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Albania / Greece,  
2017  
(Fire crossed the  
borders to Greece)

# NOFFi-OBAM Mapping Examples



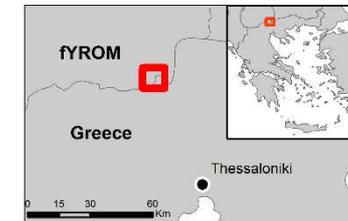
FYROM / Greece,  
2016  
(Fire crossed the  
borders to Greece)



## FYROM / GREECE

Fire Incident  
04.08.2016

Scale 1:20.000

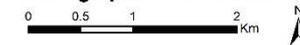


 Burned area (880.63 ha)

### Background:

 Sentinel-2 satellite image (10m)  
Acquisition date 12.08.2016

### Cartographic information:



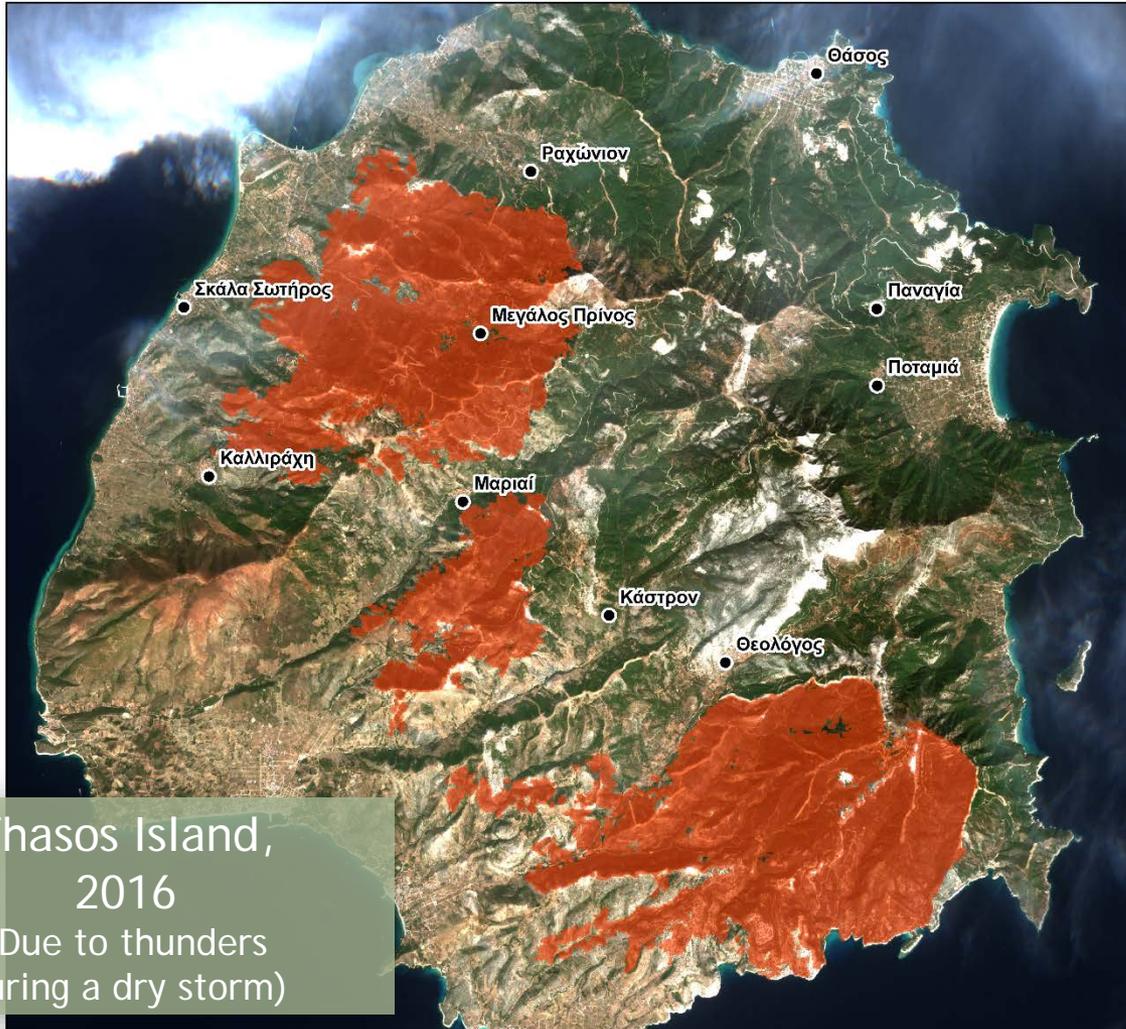
Projected Coordinate System:  
UTM Zone 34 North, Datum: WGS 84

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# NOFFi-OBAM Mapping Examples

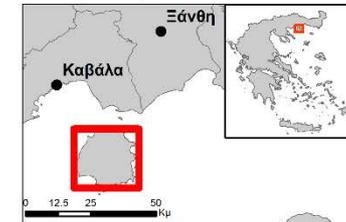


Thasos Island,  
2016  
(Due to thunders  
during a dry storm)



**ΘΑΣΟΣ**  
**Πυρκαγιές**  
**10.09.2016**

Κλίμακα 1:20.000



 Καμένη έκταση (7522.33 εκτάρια)

**Υπόβαθρο:**

 Δορυφορική εικόνα Sentinel-2 (10μ)  
Ημερομηνία λήψης 18.09.2016

**Χαρτογραφική πληροφορία:**



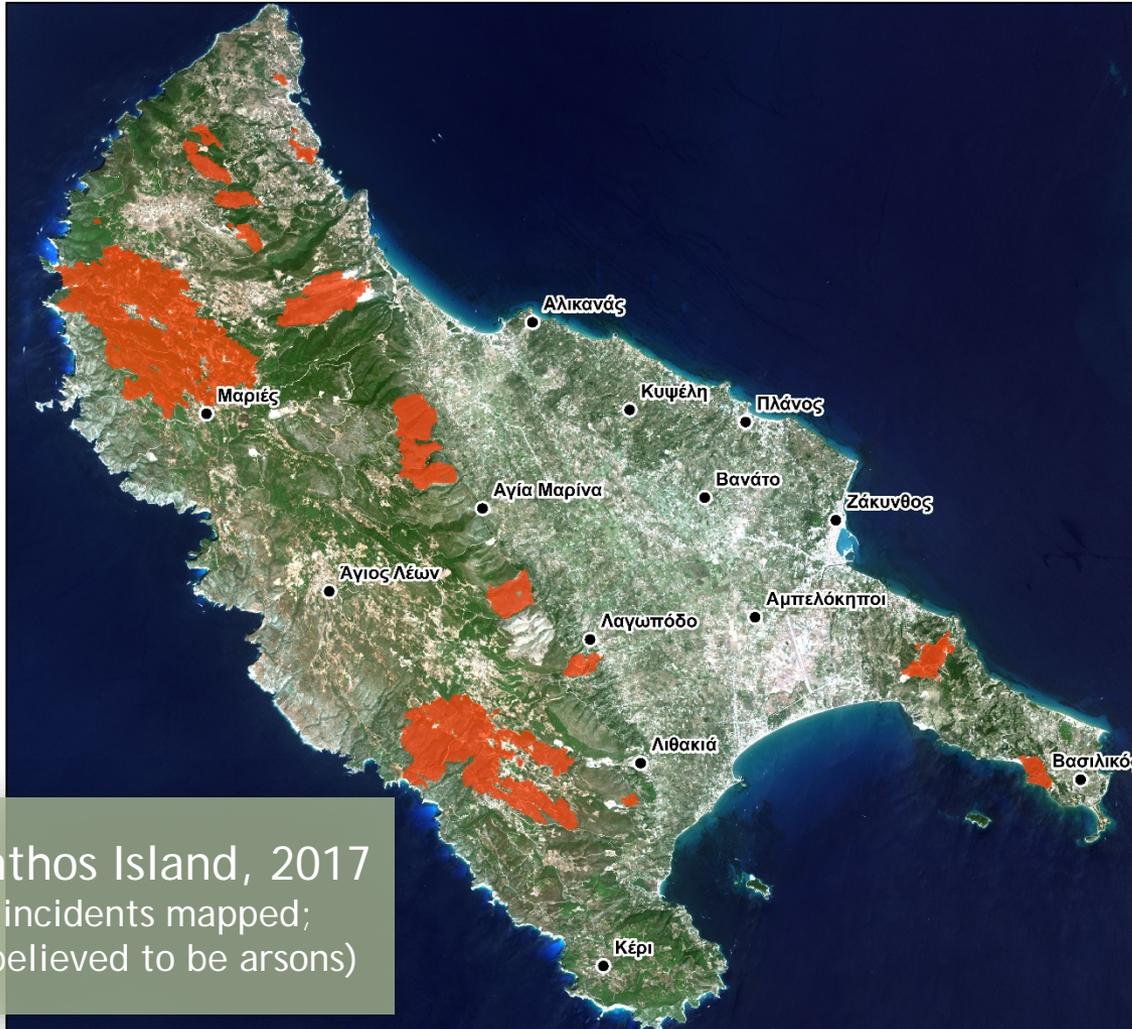
Προβολικό Σύστημα Συντεταγμένων:  
UTM Zone 35 North, Datum: WGS 84

Η χαρτογράφηση εντάσσεται στο πλαίσιο του ερευνητικού προγράμματος "Εθνικό Παρατηρητήριο Δασικών Πυρκαγιών - ΕΠαΔαΠ", το οποίο υλοποιείται από το εργαστήριο Δασικής Διαχειριστικής και Τηλεπισκόπησης του ΑΠΘ σε συνεργασία με την Γενική Διεύθυνση Αναπτυξής και Προστασίας Δασών και Αγροπεριβάλλοντος του Υπουργείου Περιβάλλοντος και Ενέργειας



Διακρίνεται ότι η περιμετρική πληγείσα έκταση, όπως έχει αποτυπωθεί μετά από ανάληψη δορυφορικών εικόνων, μέσω της υπηρεσίας NOFFi-OBAM, απεικονίζει την κατάσταση κατά την ημέρα και ώρα λήψης των εικόνων από τους δορυφόρους και σε καμία περίπτωση δεν είναι διακριτική και δεν υποκαθιστά την οριοθετημένη πληγείσα έκταση από τους αρμόδιους φορείς και υπηρεσίες με βάση το ισχύον θεσμικό πλαίσιο.

# NOFFi-OBAM Mapping Examples



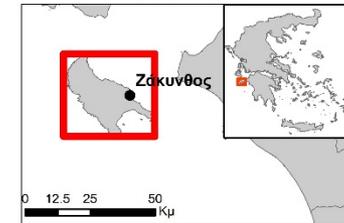
Zakynthos Island, 2017  
(17 incidents mapped;  
most believed to be arsons)



## ΖΑΚΥΝΘΟΣ

Πυρκαγιές περιόδου (17)  
08.07.2017 - 05.09.2017

Κλίμακα 1:20.000



 Καμένη έκταση (3,218.46 εκτάρια)

### Υπόβαθρο:

 Δορυφορική εικόνα Sentinel-2 (10μ)  
Ημερομηνία λήψης 18.07.2017

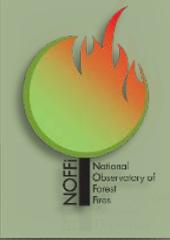
### Χαρτογραφική πληροφορία:

 0 1.25 2.5 5 Χλμ  
N  
Προβολικό Σύστημα Συντεταγμένων:  
UTM Zone 34 North, Datum: WGS 84

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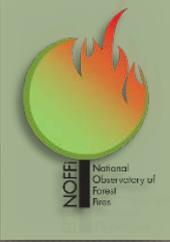


Διακρίνεται ότι η περιμετρική της πηλίκιας έκτασης, όπως έχει αποτυπωθεί μετά από ανάληψη δορυφορικών εικόνων, μέσω της υπηρεσίας NOFFi-OBAM, απεικονίζει την κατάσταση κατά την ημέρα και ώρα λήψης των εικόνων από τους δορυφόρους και σε καμία περίπτωση δεν είναι διακριτική και δεν υποκαθιστά την οριοθέτηση πηλίκιας έκτασης από τους αρμόδιους φορείς και υπηρεσίες με βάση ισχύον θεσμικό πλαίσιο.



## Mid-term fire danger index (NOFFi-MFDI)

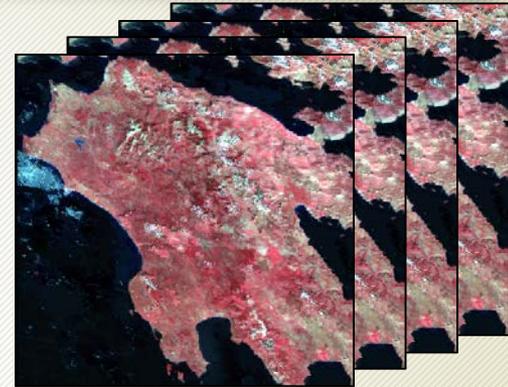
- ❑ Dynamically updated midterm fire danger estimations (**8 days ahead**)
- ❑ Modern approach based on **optical satellite observations** and auxiliary thematic layers (no meteorological predictions)
- ❑ Use of satellite imagery for estimating **vegetation dryness** and, subsequently, **dry fuel connectivity**
- ❑ Automated implementation within the **free and open source R** programming environment
- ❑ Close **collaboration** with European entities that developed similar products (PREFER FP7 project)



## Mid-term fire danger index (NOFFi-MFDI)

### □ Data used/required:

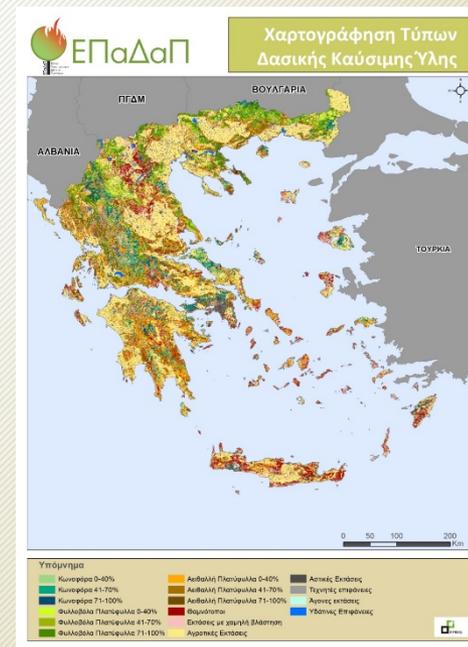
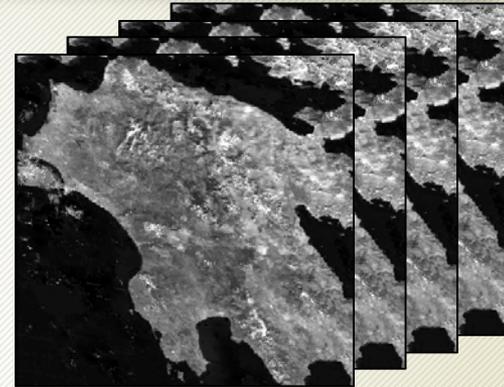
- Time-series of **MODIS** imagery (8-days composites): 10 years history (March–October) [302 images for each study area]



# Mid-term fire danger index (NOFFi-MFDI)

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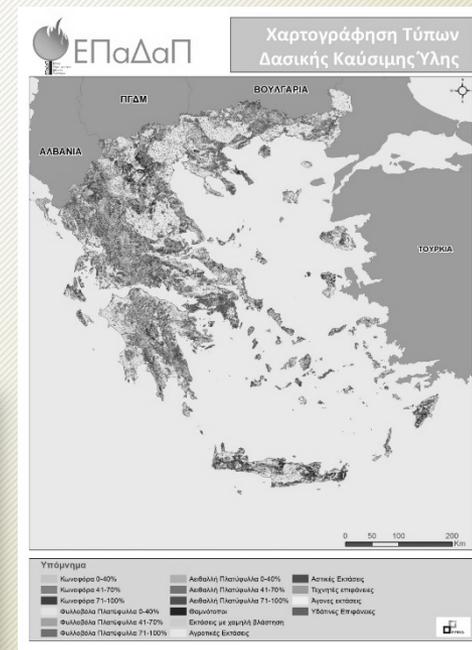
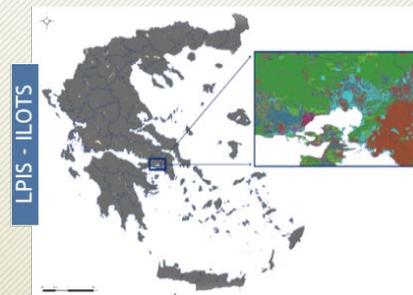
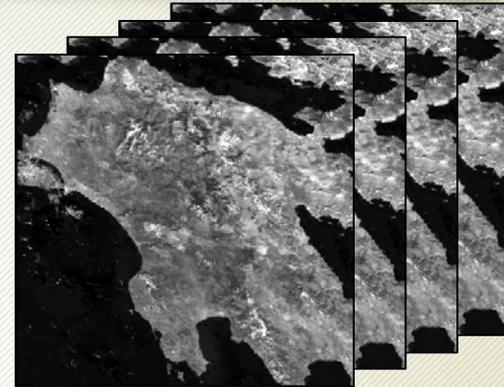
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- Fuel type map (**NOFFi-FTM**)



# Mid-term fire danger index (NOFFi-MFDI)

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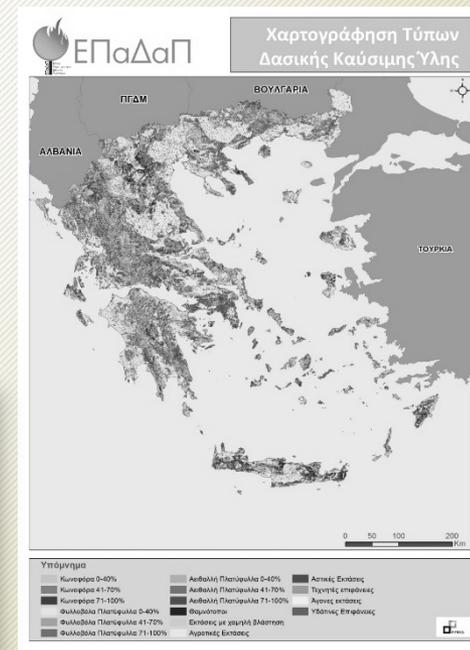
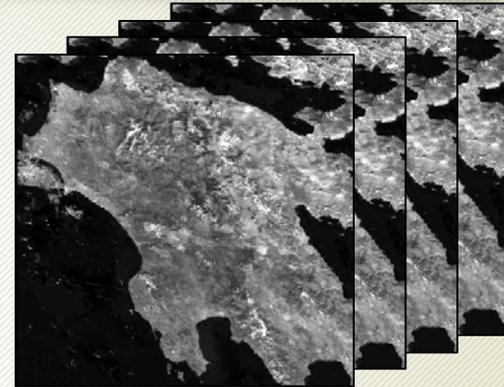
- Time-series of **MODIS** imagery (8-days composites): 10 years history (March–October) [302 images for each study area]
- Fuel type map (**NOFFi-FTM**)
- Land Parcel Identification System (**LPIS 2012**) [distance from croplands & urban areas]



# Mid-term fire danger index (NOFFi-MFDI)

## □ Data used/required:

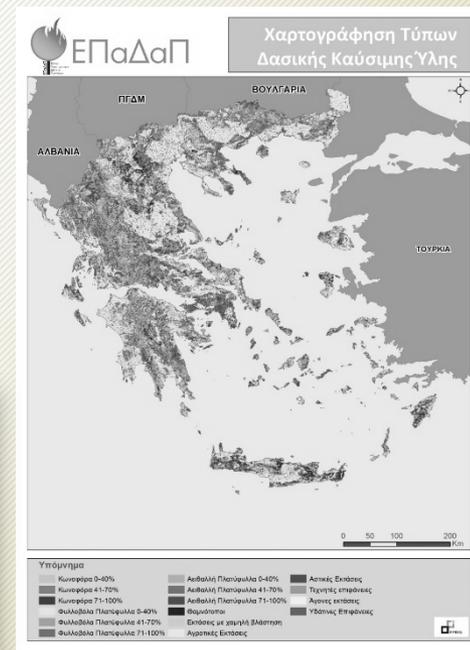
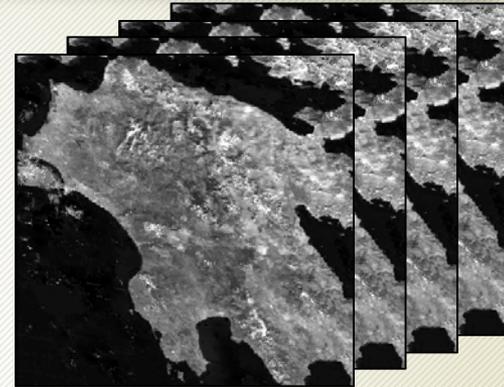
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- Fuel type map (**NOFFi-FTM**)
- Land Parcel Identification System (**LPIS 2012**) [distance from croplands & urban areas]
- Digital elevation model (**ASTER GDEM**) [for altitude, slope, exposure]

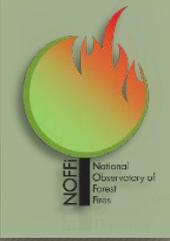


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- Fuel type map (**NOFFi-FTM**)
- Land Parcel Identification System (**LPIS 2012**) [distance from croplands & urban areas]
- Digital elevation model (**ASTER GDEM**) [for altitude, slope, exposure]
- Road network (**OpenStreetMap** – OSM)

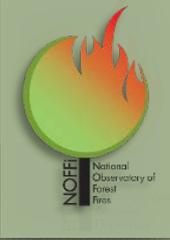




## Mid-term fire danger index (NOFFi-MFDI)

### □ Methodology:

- 1) Estimation of **dry fuel connectivity** [Caccamo et al. 2012]:  
proxy of vegetation dryness
  - a) Normalized difference infrared index (NDII) from MODIS images
  - b) Savitzky-Golay smoothing filter on time-series
  - c) Calculation of relative deviation (z-scores)
  - d) Discretization (low, medium, high & very high)
  - e) Determination of final dry fuel connectivity (neighborhood graph)

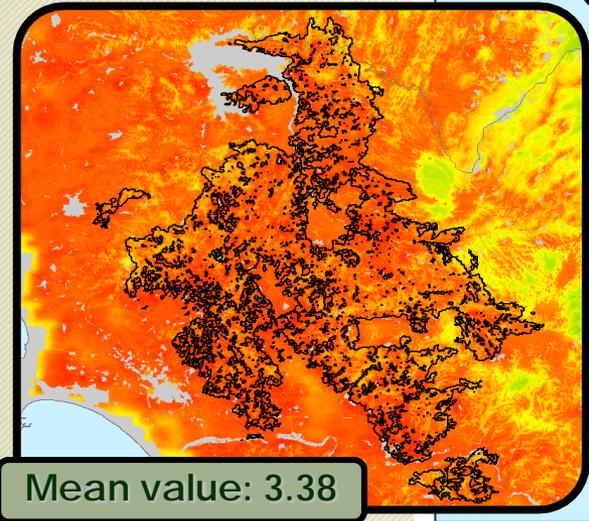
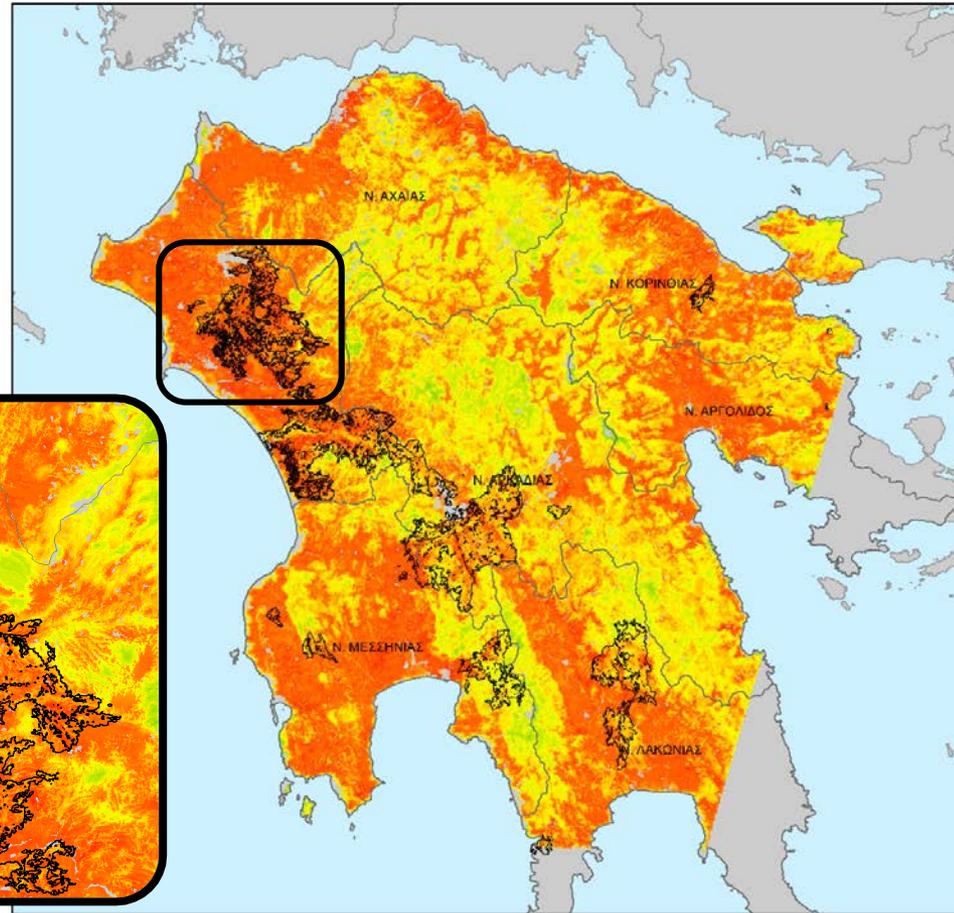


## Mid-term fire danger index (NOFFi-MFDI)

### □ Methodology:

- 2) Combination of dry fuel connectivity with fuel types distribution and topography through **multi-criteria analysis**
  - a) **Weight** calculation for each parameter following an Analytical Hierarchy Process [Saaty 1990]
  - b) **Discretization** of each parameter following the fire danger classification scheme (low, medium, high, very high)
  - c) Multi-criteria analysis; **final product resolution: 30 m**

# NOFFi-MFDI Example: Peloponnese megafires of 2007

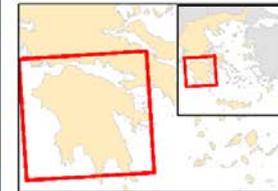


Mean value: 3.38

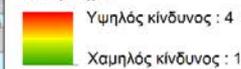


**ΠΕΛΟΠΟΝΝΗΣΟΣ**  
**21.08.2007 - 29.08.2007**

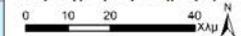
Κλίμακα 1:1,000,000



**Υπόμνημα**



**Χαρτογραφική πληροφορία:**



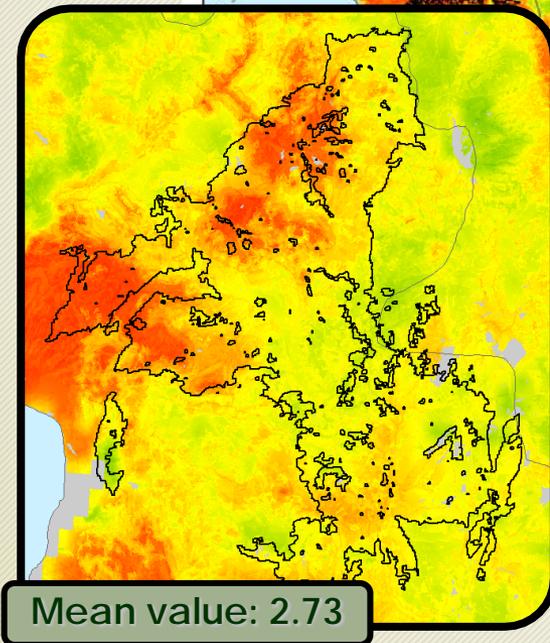
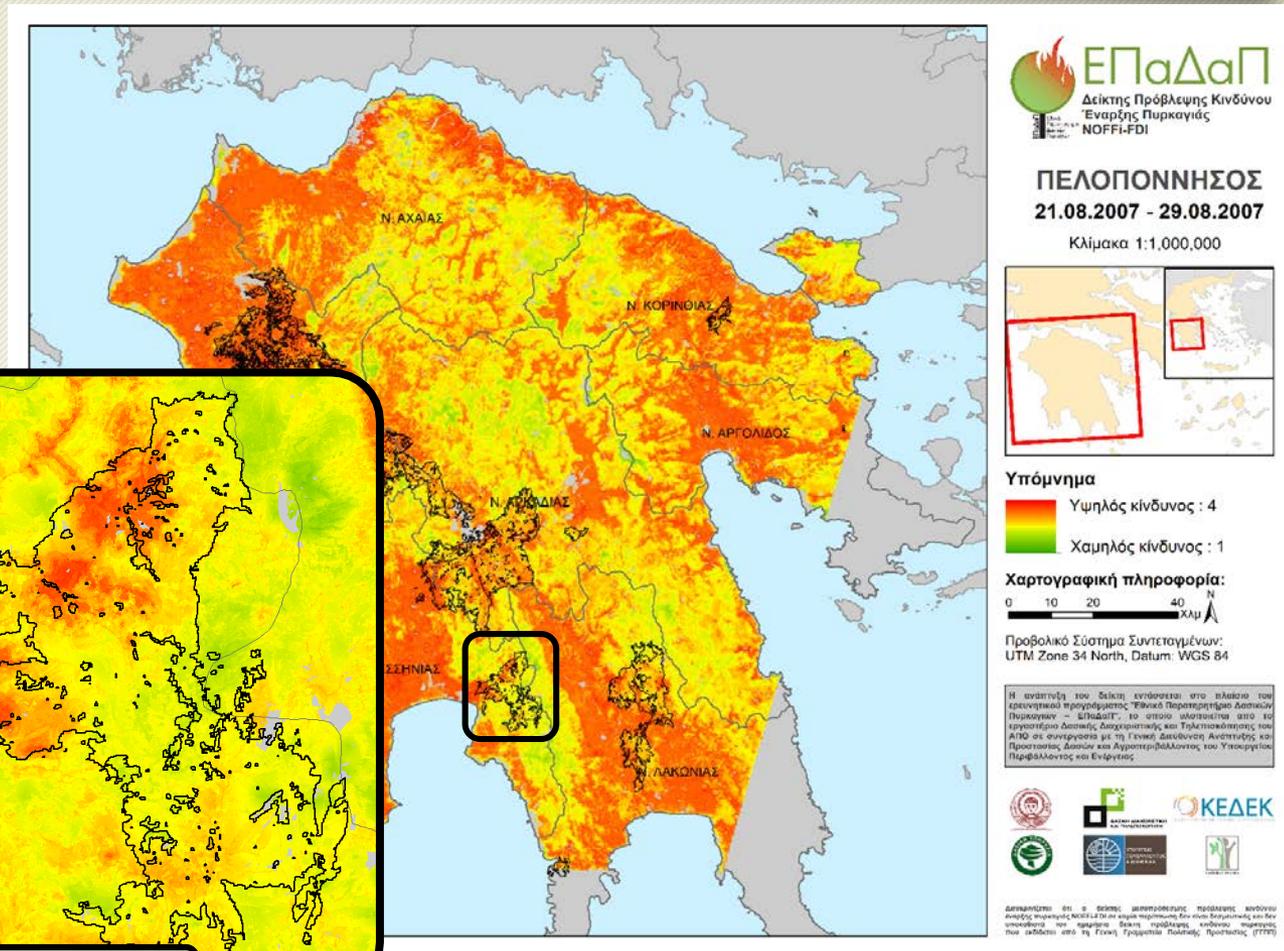
Προβολικό Σύστημα Συντεταγμένων:  
UTM Zone 34 North, Datum: WGS 84

Η ανάπτυξη του δείκτη ενδυναμείται στο πλαίσιο του ερευνητικού προγράμματος "Εθνικό Περιφερειακό Δομικό Πυρκαγιάς - ΕΠαΔαΠ", το οποίο υλοποιείται από τη μεγαλύτερη Διεύθυνση Διαχείρισης και Τηλεπισκόπησης της ΑΠΘ σε συνεργασία με τη Γενική Διεύθυνση Ανάπτυξης και Προστασίας Δασών και Αγροπεριβάλλοντος του Υπουργείου Περιβάλλοντος και Ενέργειας.

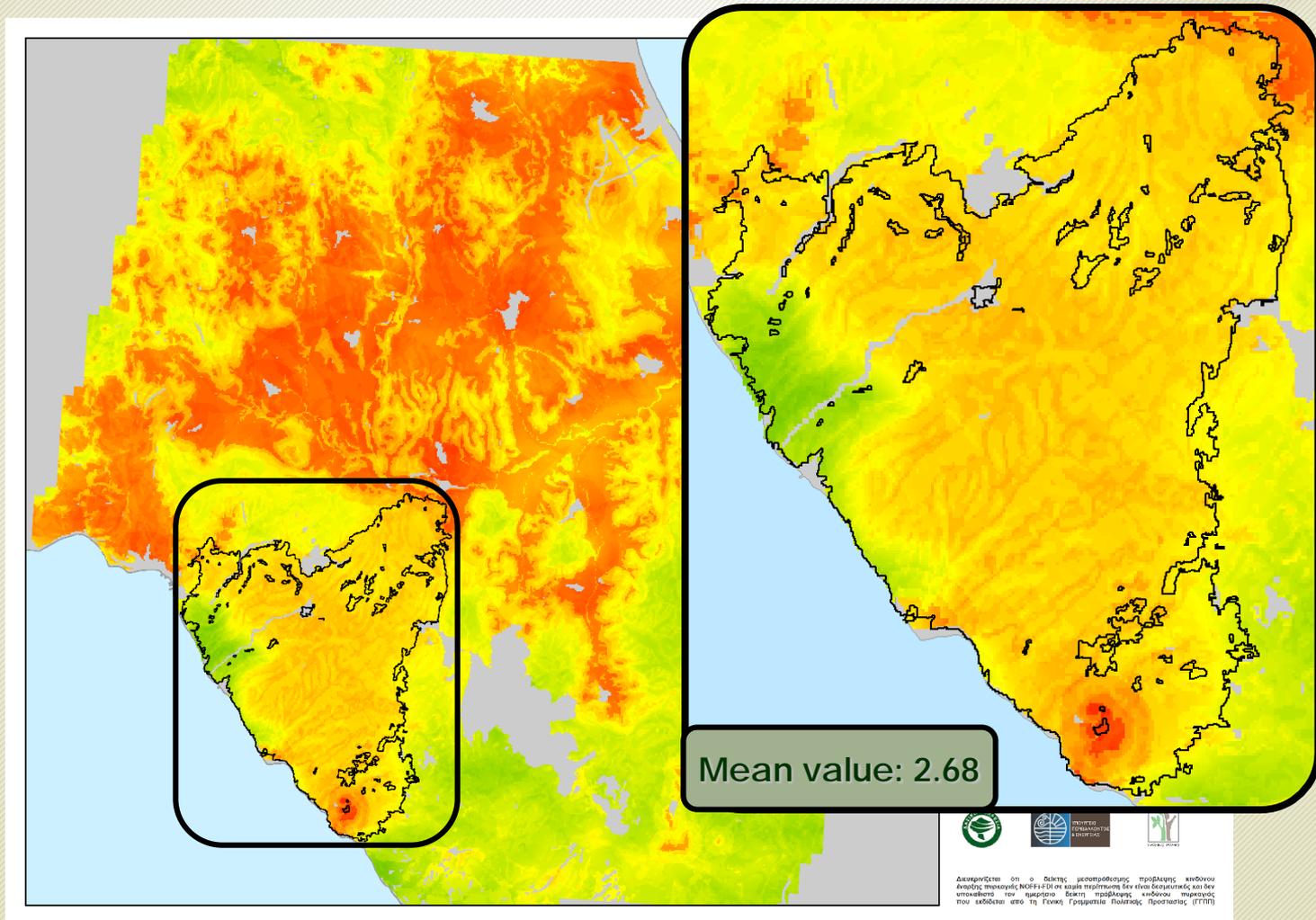


Διευθυντής: Δρ. Α. Κωνσταντίνου  
Επίκουρος Καθηγητής: Δρ. Α. Κωνσταντίνου

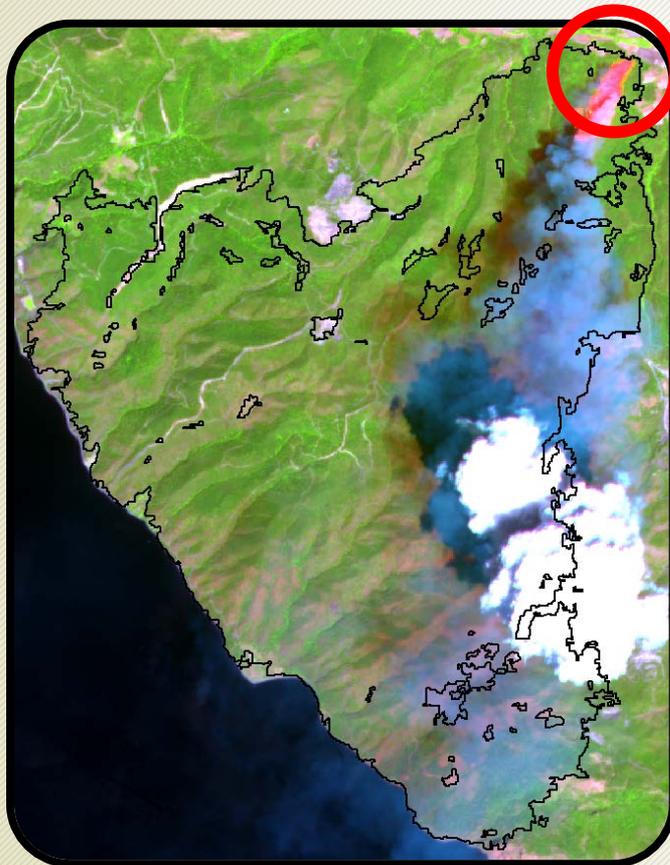
# NOFFi-MFDI Example: Peloponnese megafires of 2007



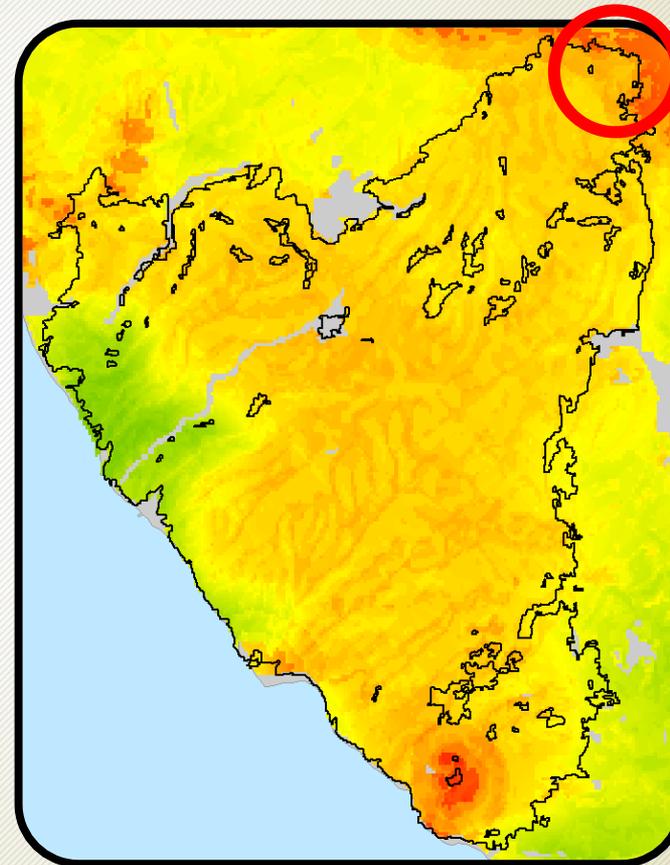
# NOFFi-MFDI Example: Euboea in July 2016



## NOFFi-MFDI Example: Euboea in July 2016

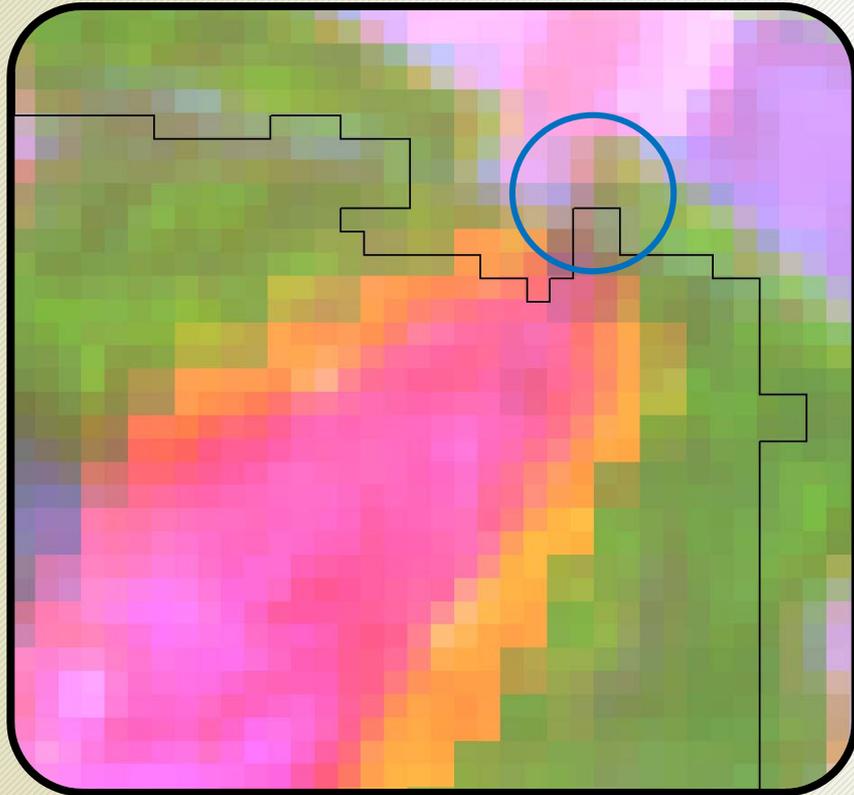


Sentinel-2 image  
acquired on 30/07/2016

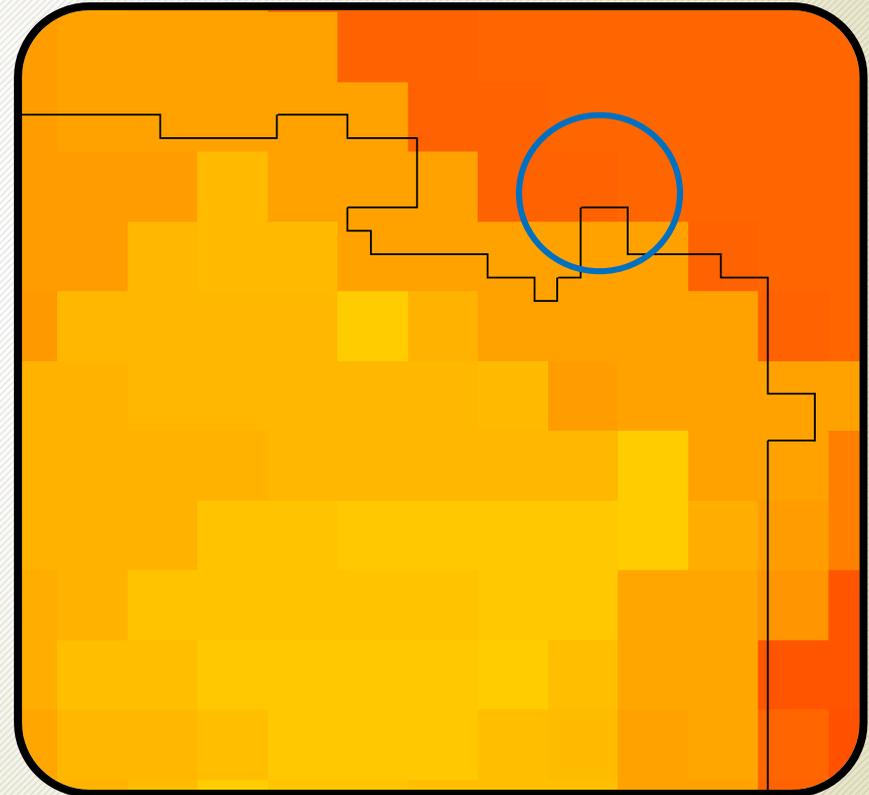


NOFFi-MFDI  
27/07/2016 – 04/08/2016

## NOFFi-MFDI Example: Euboea in July 2016

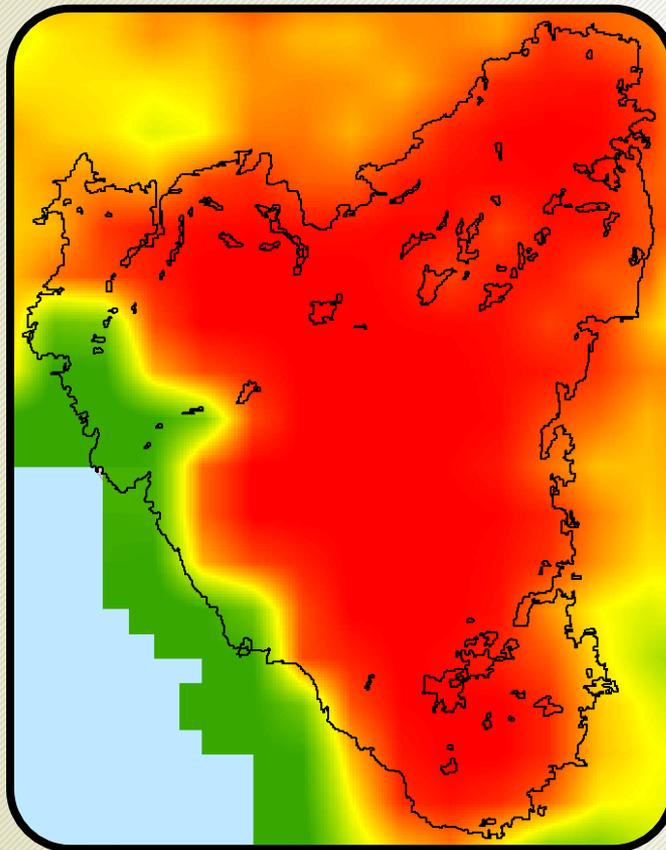


Sentinel-2 image  
acquired on 30/07/2016

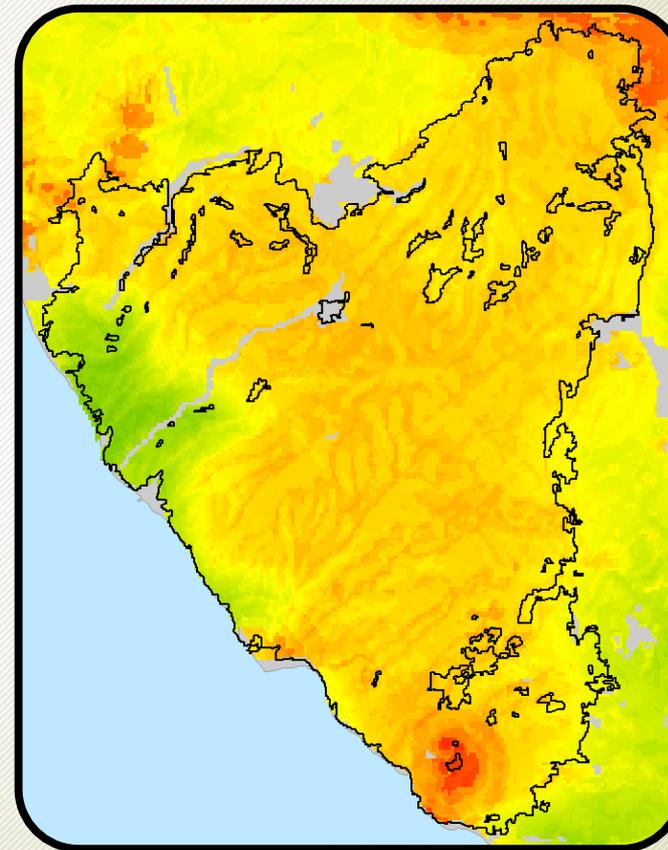


NOFFi-MFDI  
27/07/2016 – 04/08/2016

## NOFFi-MFDI Example: Euboea in July 2016



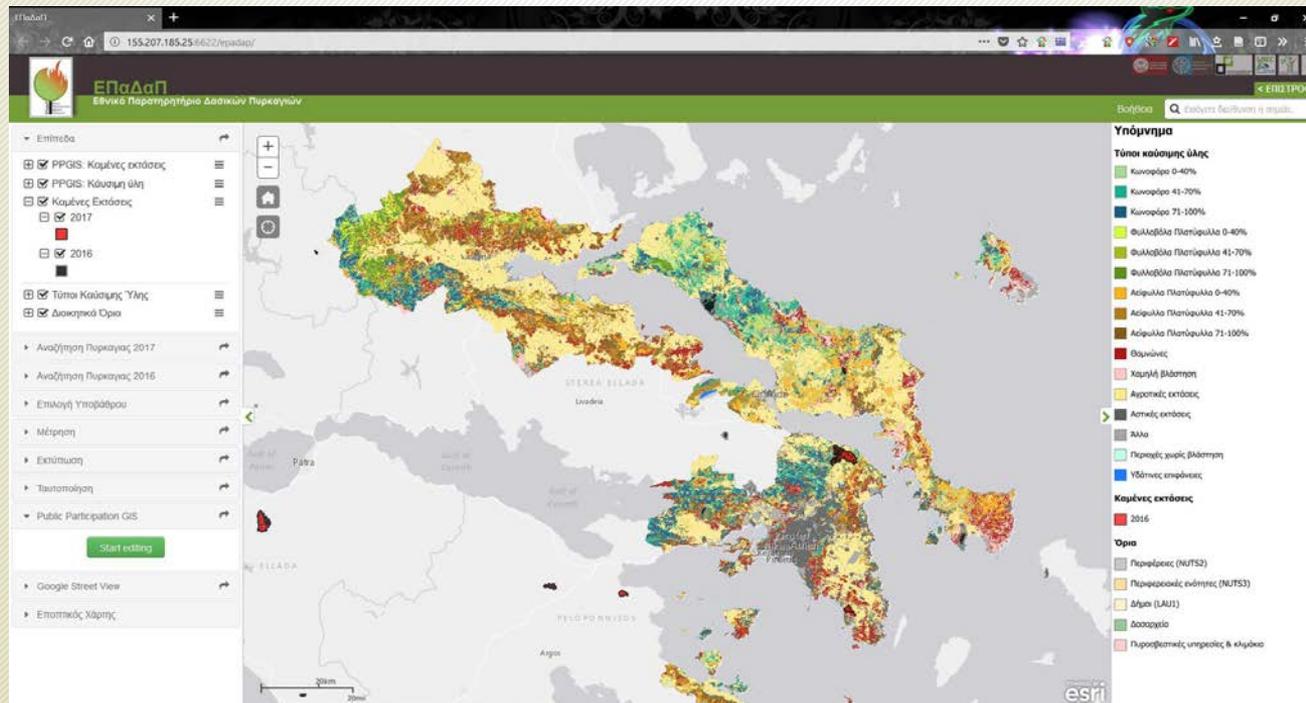
MODIS-derived dry fuel  
connectivity map (500 m)



NOFFi-MFDI map (30 m)

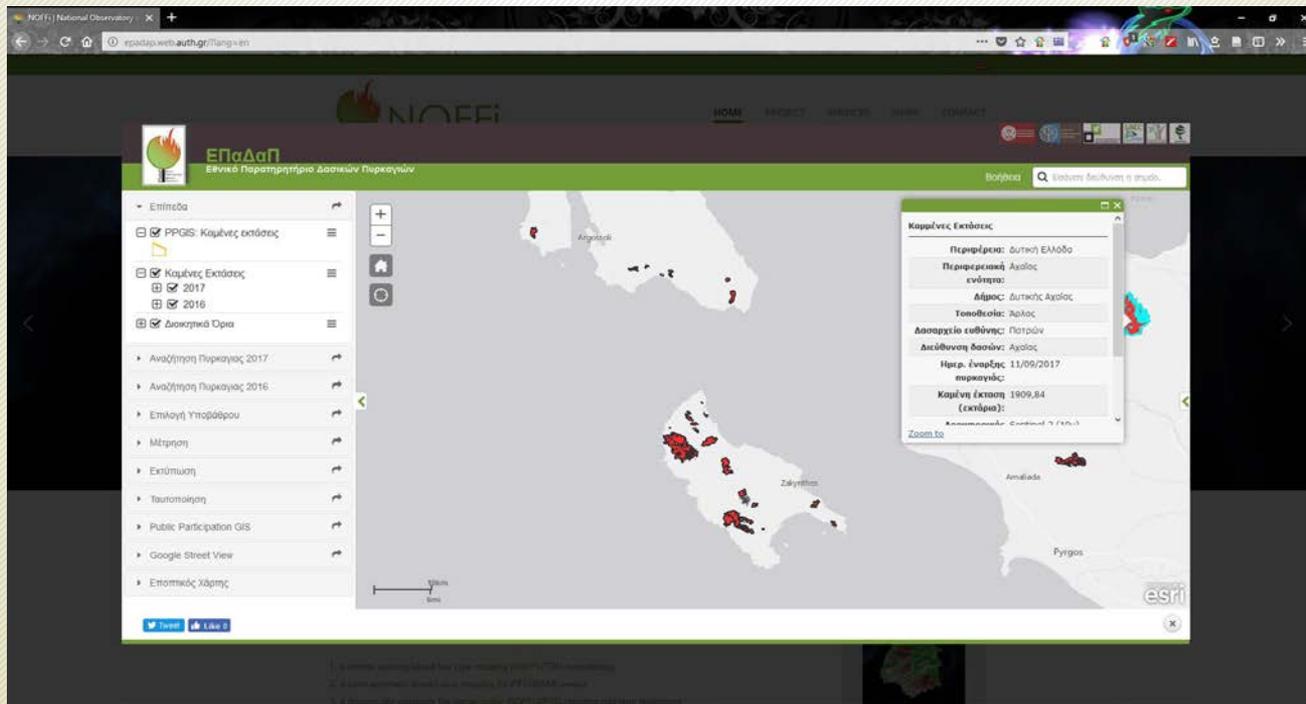
# Web-based GIS platform

- Instant access to NOFFi products
- Public Participation GIS tool (PPGIS)
- More information: <http://epadap.web.auth.gr/>



# Web-based GIS platform

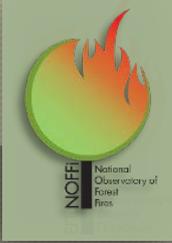
- Instant access to NOFFi products
- Public Participation GIS tool (PPGIS)
- Burned area **viewing service**, open to the public
- More information: <http://epadap.web.auth.gr/>



The screenshot displays the NOFFi web-based GIS platform interface. The main map shows the geographical outline of Greece with several red and black markers indicating burned areas. A detailed information window is open, providing the following data:

Καμένης Εκτάσεως	
Περιφέρεια:	Δυτική Ελλάδα
Περιφερειακή ενότητα:	Αχαΐας
Δήμος:	Δυτικής Αχαΐας
Τοποθεσία:	Αρκαίο
Διοικητικό εμβλημα:	Πατρών
Διαθέσιμη δασών:	Αχαΐας
Ημερ. έναρξης:	11/09/2017
συναγώνες:	
Καμένη έκταση:	1909,84
(εκατόμ):	

The interface also includes a sidebar with navigation options such as 'Επιπεδο', 'PPGIS: Καμένης εκτάσεως', and 'Καμένες Εκτάσεως'. The top navigation bar includes 'HOME', 'ΑΡΧΕΙΟ', 'ΑΝΑΖΗΤΗΣΗ', 'ΣΥΝΕΡΓΑΖΟΜΕΝΟΙ', and 'ΕΠΙΚΟΙΝΩΣΗ'.



## Transboundary cooperation

- ❑ i-BEC uses its network for the **promotion of the products and services** to neighboring **Balkan** countries
- ❑ Organization of webinar for **knowledge transfer** to stakeholders in the **Balkan region** (provisionally scheduled for mid-December 2017)
- ❑ NOFFi envisions to establish a **Balkan network** for **collaborative forest fire management**, through:
  - the development of compatible products and services for fire prevention in the Balkan region,
  - assistance in designing cross-border impact mitigation measures,
  - communication between the relevant national authorities in protecting the common forest resources

Thank you  
for your attention



<http://epadap.web.auth.gr/>

**Laboratory of Forest Management and Remote Sensing  
Aristotle University of Thessaloniki, Greece**

<http://fmrs.web.auth.gr/>